

Internet Engineering Task Force	L. Masinter	
Internet-Draft	Adobe	
Intended status: Informational	January 11, 2011	
Expires: July 15, 2011		

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## **MIME and the Web**

**draft-masinter-mime-web-info-02**

### **Abstract**

This document describes some of the ways in which parts of the MIME system, originally designed for electronic mail, have been used in the Web, and some of the ways in which those uses have resulted in difficulties. Given this background and justification, this document then goes on to outline requirements for changes to MIME registries and practices for their use within W3C and IETF, in order to address those difficulties. Within IETF, it is expected that a companion Best Current Practice document will make specific changes to the Internet Media Types and Charset registries, among others.

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## 1. Introduction

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This document was prompted by discussions about Web architecture and the difficulties surrounding evolution of the Web, Internet Media types, multiple specifications for a single media type, and related discussions.

The document gives some of the history of MIME and its introduction and use in the Web [Section 2 \(History\)](#). It then describes some of the current difficulties with the use of MIME in the Web context [Section 3 \(Problems with application to the Web\)](#). This background and context is then followed by a description of changes which would reduce some of those difficulties; the changes involve specifications, practices, and registries within IETF and W3C [Section 5 \(Recommendations\)](#). In particular, changes to the registry and maintenance procedures for MIME-related registries maintained by IANA are describes.

Currently, discussion of this document is suggested on the mailing list [www-tag@w3c.org](mailto:www-tag@w3c.org) (mailing list open for subscription to all), archives at <http://lists.w3.org/Archives/Public/www-tag/>.

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## 2. History

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### 2.1. Origins of MIME

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MIME ("Multipurpose Internet Mail Extensions") was invented originally for email, based on general principles of "messaging" (a foundational architecture framework). The role of MIME was to extend Internet email messaging from ASCII-only plain text, to include other character sets, images, rich documents, etc.) [\[RFC1521\] \(Borenstein, N. and N. Freed, "MIME \(Multipurpose Internet Mail Extensions\) Part One: Mechanisms for Specifying and Describing the Format of Internet Message Bodies," .\)](#), [\[RFC1522\] \(Moore, K., "MIME \(Multipurpose Internet Mail Extensions\) Part Two: Message Header Extensions for Non-ASCII Text," September 1993.\)](#). The basic architecture of complex content messaging is:

\*Message sent from A to B.

\*Message includes some data. Sender A includes standard 'headers' telling recipient B enough information that recipient B knows how sender A intends the message to be interpreted.

\*Recipient B gets the message, interprets the headers for the data and uses it as information on how to interpret the data.

MIME is a "tagging and bagging" specification:

**tagging:** How to label content so the intent of how the content should be interpreted is known.

**bagging:** How to wrap the content so the label is clear, or, if there are multiple parts to a single message, how to combine them.

"MIME types" (renamed "Internet Media Types" in later specs [\[RFC2046\]](#) (Freed, N. and N. Borenstein, "Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types," November 1996.)) are part of the "tagging" -- a way to describe the content of a message so that it could be used to initiate interpretation of a message. The "Internet Media Type registry" (MIME type registry) is where someone can tell the world what a particular label means, as far as the sender's intent of how recipients should process a message of that type, and the description of a recipients capability and ability for senders.

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## 2.2. Introducing MIME into the Web

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The original World Wide Web (the 0.9 version of HTTP, see [\[RFC1945\]](#) (Berners-Lee, T., Fielding, R., and H. Nielsen, "Hypertext Transfer Protocol -- HTTP/1.0," May 1996.)) didn't have "tagging and bagging" -- everything sent via HTTP was assumed to be HTML. However, at the time (early 1990's) other distributed information access systems, including Gopher (distributed menu system) and WAIS (remote access to document databases) were adding capabilities for accessing many things other text and hypertext and the WWW folks were considering type tagging. It was agreed that HTTP should use MIME as the vocabulary for talking about file types and character sets. The result was that HTTP 1.0 added the "content-type" header, following (more or less) MIME. Later, for content negotiation, additional uses of this technology (in 'Accept' headers) were also added.

The differences between the use of Internet Media Types between email and HTTP have minor:

\*default charset: HTTP originally specified ISO-8859-1 as the default character set, not US-ASCII ((NEED REF TO HTTP ISSUE see <http://trac.tools.ietf.org/wg/httpbis/trac/ticket/20>; the text that it refers to currently is here: <http://greenbytes.de/tech/webdav/draft-ietf-httpbis-p3-payload-11.html#rfc.section.2.3.1> ))

\*requirement for CRLF in plain text: in practice, Web clients didn't restrict content to use CRLF in text/\* MIME bodies.

These minor differences have caused a lot of trouble.

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### 2.3. Distributed Extensibility

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The real advantage of using Internet Media Types to label content meant that the Web was no longer restricted to a single format. This one addition meant expanding from Global Hypertext to Global Hypermedia (as suggested in [a 1992 email \(Connolly, D., "Global Hypermedia," Oct 1992.\)](#) [connolly92])

The Internet currently serves as the backbone for a global hypertext. FTP and email provided a good start, and the gopher, WWW, or WAIS clients and servers make wide area information browsing simple. These systems even interoperate, with email servers talking to FTP servers, WWW clients talking to gopher servers, on and on.

This currently works quite well for text. But what should WWW clients do as Gopher and WAIS servers begin to serve up pictures, sounds, movies, spreadsheet templates, postscript files, etc.? It would be a shame for each to adopt its own multimedia typing system.

If they all adopt the MIME typing system (and as many other features from MIME as are appropriate), we can step from global hypertext to global hypermedia that much easier.

The fact that HTTP could reliably transport images of different formats, for example, allowed NCSA to add <img> to HTML. MIME allowed other document formats (Word, PDF, Postscript) and other kinds of hypermedia, as well as other applications, to be part of the Web. MIME was arguably the most important extensibility mechanism in the Web.

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## 3. Problems with application to the Web

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Unfortunately, while the use of Internet Media Types for the Web added incredible power, a number of problems have arisen.

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### 3.1. Lack of clarity

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Many people are confused about the purpose of MIME in the Web, its uses, the meaning of Internet Media Types. Many W3C specifications TAG

findings and Internet Media Type registrations make what are incorrect assumptions about the meaning and purposes of a Internet Media Type registration.

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### 3.2. Differences between email and Web delivery

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Some of the differences between the application contexts of email and Web delivery determine different requirements:

\*In the Web, the transfer of data is initiated differently than in email: the "messages" with labeled content are usually HTTP responses to a specific (GET) request (although the request is itself a message, GET has no content). In the most common case, then, the receiver knows more about the data before it has been sent.

\*Clients would like to know more about the content before they retrieve it. The "tagging" is often not sufficient to know, for example, "can I interpret this if I retrieve it", because of versioning, capabilities, or dependencies on things like screen size or interaction capabilities of the recipient.

\*Some content isn't delivered over the HTTP (files on local file system), or there is no opportunity for tagging (data delivered over FTP) and in those cases, some other ways are needed for determining file type.

Operating systems use (and continued to evolve) different systems to determine the 'type' of something, different from the MIME tagging and bagging:

\*'magic numbers': in many contexts, file types can be guessed by looking for some unique string, number or pattern, which only appears in files of that type. In circumstances where this was a unique number, it was called a "magic number", although this concept has been extended to other textual patterns.

\*Originally MAC OS had a 4 character 'file type' and another 4 character 'creator code' for file types.

\*Windows evolved to use the "file extension" -- 3 letters (and then more) at the end of the file name -- as the initial determination of the overall type of a file. This practice has now extended to other systems.

Information about these other ways of determining type (rather than by the content-type label) were gathered for the Internet Media Type

registry; those registering types are encouraged to also describe 'magic numbers', Mac file type, common file extensions. However, since there was no formal use of that information, the quality of that information in the registry is haphazard.

Finally, there was the fact that tagging and bagging might be OK for unilaterally initiated (one-way) messaging, you might want to know whether you could handle the data before reading it in and interpreting it, but the Internet Media Types weren't enough to tell.

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### 3.3. The Rules Weren't Quite Followed

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The behavior of the community when the Internet Media Type registry was designed hasn't matched expectations:

- \*Lots of file types aren't registered (no entry in IANA for file types)

- \*For many file types that are registration, the registration is incomplete or incorrect (people doing registration didn't understand 'magic number' or other fields).

- \*The actual content deployed or created by deployed software doesn't match the registration.

These problems arise for various reason, for example:

- \*The benefit of registration to the organization that designed the file type is unclear compared to the overhead of sheperding the registration through the process.

- \*Registration requires announcing product plans in advance of product release.

- \*Orgnaizations are unaware of the registration process or misinformed.

In particular, Web implementations of Internet Media Types diverged from expected behavior:

- \*Browser implementors would be liberal in what they accepted, and use what looked like a file extension in the URL and/or magic number or other "sniffing" techniques to decide file type, without assuming content-label was authoritative. This was necessary anyway for files that weren't delivered by HTTP.

- \*HTTP server implementors and administrators didn't supply ways of easily associating the 'intended' file type label with the file,

resulting in files frequently being delivered with a label other than the one they would have chosen if they'd thought about it, and if browsers \*had\* assumed content-type was authoritative. Some popular servers had default configuration files that treated any unknown type as "text/plain" (plain ext in ASCII). Since it didn't matter (the browsers worked anyway), it was hard to get this fixed.

Thus, in many situations, because of poor control over server administration or weak file-type detection in popular web server technology, receivers might find that 'magic number' scanning was more reliable than the actual labeled content-type.

Incorrect senders coupled with liberal readers wind up feeding a negative feedback loop based on the robustness principle ([\[WikiRobust\]](#) ([, "Robustness principle," 2010.](#)), [\[RFC3117\]](#) (Rose, M., "On the Design of Application Protocols," November 2001.)).

In addition, since the "magic number" technology is heuristic, it is possible to have different formats all with the same "magic number" or more generally, more than one different format that might be reasonably "sniffed".

For example, there are cases where the reuse of one file type's magic number for another file type is intentional -- deliberate "puns", attempts to usurp ownership of another vendor, group, or standards organization's control over a file format, for example.

Secondly, there are cases where a single file might match more than one 'magic number' or recognition pattern, and different receivers apply heuristics differently.

Finally, there are simple cases where the labeled type (text/plain, application/octet-stream) is more general and could reasonably be used with content which might otherwise match other patterns.

For example, the sniffing that's done by some web browsers text/plain. If you serve it the perfectly valid text file with the content:

```
<?xml version="1.0"?>
<animals>
  <dog>Rufus</fish>
  <cat>Kitty</elephant>
</animals>
```

the browser will not display it (there are intentionally mismatched tags on the 3rd line). Something like this might come up, for example, if you had a bug database, with links to the text of documents that caused problems. This buggy XML, served as text/plain, should render, but it does not in browsers that incorrectly guess "application/xml". The "<?xml" is treated as a "magic number", and the wrong thing is happening. The browser thinks "surely it's XML"; the bug tracking app knows "on the contrary, I'm serving it as text precisely because I know it's not".



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### 3.4. Consequences

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The result, alas, is that increased unreliability, in that

- \*servers sending responses to browsers don't have a good guarantee that the browser won't "sniff" the content and decide to do something other than treat it as it is labeled

- \*browsers receiving content don't have a good guarantee that the content isn't mis-labeled

- \*intermediaries (gateways, proxies, caches, and other pieces of the Web infrastructure) don't have a good way of telling what the conversation means.

This ambiguity and 'sniffing' also applies to the W3C developed Widget Packaging and Configuration [\[Widgets\] \(Cáceres, M., "Widget Packaging and Configuration," .\)](#) (a kind of 'bagging' using ZIP rather than MIME multipart).

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### 3.5. The Down Side of Extensibility

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Extensibility adds great power, and allows the Web to evolve without committee approval of every extension. For some (those who want to extend and their clients who want those extensions), this is power! For others (those who are building Web components or infrastructure), extensibility is a drawback -- it adds to the unreliability and difference of the Web experience. When senders use extensions recipients aren't aware of, implement incorrectly or incompletely, then communication often fails. With messaging, this is a serious problem, although most 'rich text' documents are still delivered in multiple forms (using multipart/alternative).

If your job is to support users of a popular browser, however, where each user has installed a different configuration of file handlers and extensibility mechanisms, MIME may appear to add unnecessary complexity and variable experience for users of all but the most popular types.

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## 4. Additional considerations

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This section notes some additional considerations.

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#### **4.1. There are related problems with charsets**

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MIME includes provisions not only for file 'types', but also, importantly the "character encoding" used by text types: for example, simple US ASCII, Western European ISO-8859-1, Unicode UTF8. A similar vicious cycle also happened with character set labels: mislabeled content happily processed correctly by liberal browsers encouraged more and more sites to proliferate text with mis-labeled character sets, to the point where browsers feel they \*have\* to guess the wrong label. (NEEDS EXPANSION)

There are sites that intentionally label content as iso-2022-jp or euc-jp when it is in fact one of the Microsoft extension charsets (e.g., for access to circled digits. This is an intentional misuse of the definitions of the charsets themselves -- definitions which originated at the national standards body level.

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#### **4.2. Embedded, downloaded, launch independent application**

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The type of a document might be determined not only for entire documents "HTML" vs "Word" vs "PDF", but also to embedded components of documents, "JPEG image" vs. "PNG image". However, the use cases, requirements and likely operational impact of MIME handling is likely different for those use cases.

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#### **4.3. Additional Use Cases: Polyglot and Multiview**

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There are some interesting additional use cases which add to the design requirements:

\*"Polyglot" documents: A 'polyglot' document is one which is some data which can be treated as two different Internet Media Types, in the case where the meaning of the data is the same. This is part of a transition strategy to allow content providers (senders) to manage, produce, store, deliver the same data, but with two different labels, and have it work equivalently with two different kinds of receivers (one of which knows one Internet Media Type, and another which knows a second one.) This use case was part of the transition strategy from HTML to an XML-based XHTML, and also as a way of a single service offering both HTML-based and XML-based processing (e.g., same content useful for news articles and Web pages.

\*"Multiview" documents: This use case seems similar but it's quite different. In this case, the same data has very different meaning when served as two different content-types, but that difference is intentional; for example, the same data served as text/html is a document, and served as an RDFa type is some specific data.

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#### 4.4. Evolution, Versioning, Forking

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The subject of format/language/type evolution is complex; this section is a little terse.

Formats and their specifications evolve over time. There are several reasons for the evolution: innovation, compatibility with other implementations, attempts to gain control.

Some times new evolutions are "compatible", although compatibility has several variations. It is part of the responsibility of the designer of a new version of a file type to try to insure both forward and backward compatibility: new documents work reasonably (with some fallback) with old viewers and that old documents work reasonably with new viewers. In some cases this is accomplished, others not; in some cases, "works reasonably" is softened to "either works reasonably or gives clear warning about nature of problem (version mismatch)."

In MIME, the 'tag', the Internet Media Type, corresponds to the versioned series. Internet Media Types do not identify a particular version of a file format. Rather, the general idea is that the Internet Media Type identifies the family, and also how you're supposed to otherwise find version information on a per-format basis. Many (most) file formats have an internal version indicator, with the idea that you only need a new Internet Media Type to designate a completely incompatible format. The notion of an "Internet Media Type" is very course-grained. The general approach to this has been that the actual Media Type includes provisions for version indicator(s) embedded in the content itself to determine more precisely the nature of how the data is to be interpreted. That is, the message itself contains further information.

Unfortunately, lots has gone wrong in this scenario as well -- processors ignoring version indicators encouraging content creators to not be careful to supply correct version indicators, leading to lots of content with wrong version indicators.

Those updating an existing Internet Media Type registration to account for new versions are admonished to not make previously conforming documents non-conforming. This is harder to enforce than would seem, because the previous specifications are not always accurate to what the Internet Media Type was used for in practice.

In addition, there are situations where there are simultaneously multiple, different specifications which all claim to authoritatively

define the same internet media type; one might be couched as 'newer' or 'better', or the specifications might be 'forked'.

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#### 4.5. Content Negotiation

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The general idea of content negotiation is when party A communicates to party B, and the message can be delivered in more than one format (or version, or configuration), there can be some way of allowing some negotiation, some way for A to communicate to B the available options, and for B to be able to accept or indicate preferences. Content negotiation happens all over. When one fax machine twirps to another when initially connecting, they are negotiating resolution, compression methods and so forth. In Internet mail, which is a one-way communication, the "negotiation" consists of the sender preparing and sending multiple versions of the message, one in text/html, one in text/plain, for example, in sender-preference order. The recipient then chooses the first version it can understand. HTTP added "Accept" and "Accept-language" to allow content negotiation in HTTP GET, based on Internet Media Types, and there are other methods explained in the HTTP spec.

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#### 4.6. Fragment identifiers

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The Web added the notion of being able to address part of a content and not the whole content by adding a 'fragment identifier' to the URL that addressed the data. Of course, this originally made sense for the original Web with just HTML, but how would it apply to other content. The URL spec glibly noted that "the definition of the fragment identifier meaning depends on the Internet Media Type", but unfortunately, few of the Internet Media Type definitions included this information, and practices diverged greatly. If the interpretation of fragment identifiers depends on the MIME type, though, this really crimps the style of using fragment identifiers differently if content negotiation is wanted.

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### 5. Recommendations

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This section outlines the kinds of changes needed to bring the MIME system in line with current practice and to address the problems outlined above. The purpose of this text is not to specify the exact

details of how changes can be accomplished, but rather to find broad agreement.

We need a clear direction on how to make the Web more reliable, not less. We need a realistic transition plan from the unreliable Web to the more reliable one. Part of this is to encourage senders (Web servers) to mean what they say, and encourage recipients (browsers) to give preference to what the senders are sending.

We should try to create specifications for protocols and best practices that will lead the Web to more reliable and secure communication. To this end, we give an overall architectural approach to use of MIME, and then specific specifications, for HTTP clients and servers, Web Browsers in general, proxies and intermediaries, which encourage behavior which, on the one hand, continues to work with the already deployed infrastructure (of servers, browsers, and intermediaries), but which advice, if followed, also improves the operability, reliability and security of the Web.

This section outlines requirements for standards and practices intended to address some of the difficulties. This is an early version, which mainly contains "strawman" proposals for changes. It is intended to stimulate discussion -- however, the hope is that we can get agreement about the nature of the problems and current situation before focusing in detail about possible solutions. However, having at least strawman proposals seems to be helpful. For some problems, additional changes to IETF and W3C specifications are also be advisable; the expectations are briefly outlined here.

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## **5.1. Internet Media Type registration**

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Update the Internet Media Type registry and registration process.

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### **5.1.1. MIME registry magic numbers for sniffing**

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Be clearer about relationship of 'magic numbers' to sniffing; review Internet Media Types already registered and update.

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### **5.1.2. Scripting and scriptable content safety**

[TOC](#)

Be clearer about requiring Security Considerations to address risks of sniffing

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### 5.1.3. Fragment identifiers

[TOC](#)

Problem: MIME type definitions don't talk about fragment identifiers. require definition of fragment identifier applicability; add fragID semantics

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### 5.1.4. Application info

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Problem: Most often, the original conception of MIME for email "attachments" was that each content body was really a separate communication; however some Internet Media Types do not have that characteristic.

Could the 'applications that use this type' section to be clearer about whether the media type is intended to be piece of self-contained content (it is sensible to store the MIME data as a file and later launch a separate application to view or interact with it) or whether it is (always, most often, not really appropriate) to do so, and instead this content is intended or embedding or processing as a part of a larger context or application. Of course there may be situations where either holds with the same media type.

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### 5.1.5. File extensions in registry

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Problem: Sniffing needs to use file extensions too; signify which file extensions are useful for sniffing. Be clearer about file extension use and relationship of file extensions to MIME handlers

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## 5.2. Sniffing

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Various new specifications discuss, promote or mandate the use of 'sniffing' -- using the content of the data to supplement or even override the declared content-type or charset. Update these specifications.

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### 5.2.1. Sniffing uses Media Type magic number

Update the proposed Media Type sniffing document ([\[mime-sniff\] \(Barth, A. and I. Hickson, "Media Type Sniffing," December 2010.\)](#)) so that sniffing uses MIME registry for 'magic numbers'.

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### 5.2.2. Sniffing when there are multiple different definitions

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Address issue of sniffing when there are multiple independent definitions of the same MIME type.

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### 5.2.3. Sniffing charsets

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Update sniffing of charsets in HTML5 ([\[HTML5-charset\] \(Hickson, I., "HTML5: A vocabulary and associated APIs for HTML and XHTML \(8.2.2.1 Determining the character encoding\)," .\)](#)) to use the charset reference info.

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### 5.2.4. Sniffing security uses scriptability info

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If the Internet Media Type registry is more explicit about which kinds of content contain what kind of scriptability access, then the specifications for sniffing can reference the Internet Media Type registry to determine what kinds of sniffing constitute a 'privilege upgrade'.

Note that all sniffing can be a privilege upgrade, if there is a buggy recipient, although bugs can be fixed, but spec violations are a problem.

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## 5.3. Changes to IANA processes for MIME registries

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Problem: Internet Media Type registries are hard to update, and there can be different definitions of the same MIME type.

STRAWMAN: Allow commenting or easier update; not all Internet Media Type owners need or have all the information the internet needs. Wiki for Internet Media Types as well as formal registry? Ability to add comments about deployed senders, deployed content, deployed receivers.

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#### 5.4. FTP specification

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Do FTP clients also change rules about guessing file types based on OS of FTP server?

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#### 5.5. Update some URI definitions

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ftp, file, need sniffing, http sometimes does; data defaults to text/plain rather than sniffing. Should this info be in the URI definitions.

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#### 5.6. Changes to W3C findings, processes

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Update Tag finding on authoritative metadata: is it possible to remove 'authority'?

new: MIME and Internet Media Type section to WebArch, referencing this memo

New: Add a W3C Web architecture material on MIME in HTML to W3C site, referencing this memo

Reconsider other extensibility mechanisms (namespaces, for example): should they use MIME or something like it?

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#### 6. Acknowledgements

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This document is the result of discussions among many individuals in the IETF and W3C. Special thanks to Alexey Melnikov, Noah Mendelsohn.

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#### 7. IANA Considerations

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This document includes no specific changes to IANA registries or processes. However, it outlines several considerations for future explicit recommendations to IANA, to change Internet Media Type and Charset registries and the processes around their maintenance. IANA evaluation of the feasibility of these changed processes is required.

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## 8. Security Considerations

This document discusses some of the security issues resulting from use (and mis-use) of MIME content types in the Web.

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## 9. Informative References

[TOC](#)

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